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44. (New) A method of forming an exit window for an electron beam emitter through which electrons pass in an electron beam comprising:

providing an exit window foil having an interior and an exterior surface; and

forming a corrosion resistant layer having high thermal conductivity over the exterior surface of the exit window foil for resisting corrosion and increasing thermal conductivity, the corrosion resistant layer comprising diamond.

REMARKS

The Specification has been amended as requested by the Examiner to provide any issued patent numbers corresponding to the referenced patent applications.

Claims 1-40 are pending in the application. In the Office Action at hand, Claims 1-40 are rejected.

Claims 1, 12, 21 and 32 are rejected under 35 U.S.C. § 102(b) as being anticipated by Avnery. In addition, Claims 2-5, 7-11, 13-16, 18-20, 22-25, 27-30, 33-36 and 38-40 are rejected under 35 U.S.C. § 103(a) as being unpatentable in view of Avnery. Furthermore, Claims 6, 11, 17, 26, 31 and 37 are rejected under Section 103(a) as being unpatentable in view of Avnery and Jacob. In response to the Section 102(b) and 103(a) rejections, the Applicant respectfully submits that Claims 1-40, as amended, are not anticipated or obvious in view of Avnery and Jacob. Reconsideration is respectfully requested.

The present invention as recited in Claim 1, as amended, is directed to an exit window for an electron beam emitter through which electrons pass in an electron beam. The electron window includes an exit window foil about 12 microns thick or less having an interior and an exterior surface. A corrosion resistant layer having high thermal conductivity is formed over the exterior surface of the exit window foil for resisting corrosion and increasing thermal conductivity.

Claim 21, as amended, is a method claim which generally parallels Claim 1, as amended. Claim 12, as amended, specifies an electron beam emitter and Claim 32, as amended, is a method claim which generally parallels Claim 12, as amended. In addition, Claim 10 recites an "exit window foil comprising titanium about 6 to 12 microns thick and the corrosion resistant layer comprising gold about .1 to 1 microns thick", and Claim 11 recites an "exit window foil comprising titanium about 6 to 12 microns thick and the corrosion resistant layer comprising diamond about .25 to 2 microns thick". Claims 30 and 31 are method claims which generally parallel Claims 10 and 11, respectively.

Claims 1, 12, 21, and 32 have been amended to recite "an exit window foil about 12 microns thick or less". Support for these amendments is found at least on page 2, lines 14-15, and page 9, lines 15-17 of the Specification as originally filed. No new matter is introduced.

In the present invention, for example, referring to FIG. 10, an exit window foil 32a about 12 microns thick or less (typically 6 to 12 microns thick), is advantageous in that electrons can pass through the exit window foil 32a at higher intensities than through standard thickness exit window foils which are typically above about 13 microns. The tradeoff for having a thinner exit window foil 32a is that the electron beam passing through the exit window foil 32a can more easily burn a hole through it. Often, a reduction in electron beam power is required to prevent the electron beam from burning such a hole. However, in cases where the exit window foil 32a is made of a material having relatively low thermal conductivity, such as titanium, the Applicant has found that a layer of corrosion resistant high thermal conductive material 32b on the exterior surface of the lower thermal conductive exit window foil 32a can increase the overall thermal conductivity of the exit window 32 so that heat generated by the electron beam passing therethrough can be more rapidly conducted away. As a result, the electron beam intensity does not need to be reduced to prevent burning a hole in the thinner exit window foil 32a, and in some cases, the intensity can be increased. In addition, by employing a corrosion resistant material on the exterior surface of exit window foil 32a, the layer of high thermal conductive material 32b and the exit window 32 experience little or no corrosion. Depending upon the materials used for the exit window foil 32a and the layer of high thermal conductive material 32b, as well as the relative thicknesses chosen, the addition of the high thermal conductive material 32b can often

increase the overall thermal conductivity of the exit window 32 over that of the exit window foil 32a alone, by a factor ranging from about 2 to 8.

In one embodiment, the exterior surface of the exit window foil 32a is covered with a layer of diamond as the high thermal conductive corrosion resistant material 32b. The layer of diamond is corrosion resistant so that the exit window foil 32a and the exit window 32 experience little or no corrosion during use. With the layer of diamond, a 6 micron titanium exit window foil 32a that would normally only be capable of withstanding power of about 4 kW, can withstand power of up to 20 kW. Although the thickness of the exit window foil 32a is typically 6 to 12 microns thick for obtaining high transmission of electrons therethrough, exit window foil thicknesses above 12 microns may be employed for operating at high power levels. The layer of diamond is typically in the range of .25 to .2 microns thick for maximizing thermal conductivity while at the same time minimizing the decrease in electron transmission through the exit window 32 due to the addition of the layer 32b. The thickness of the diamond layer can be chosen depending upon the operating power, the thickness of the exit window, etc. In some situations, the layer of diamond is about 4% to 8% the thickness of the exit window foil. Diamond has a relatively low density for a material having high thermal conductivity, which helps minimize the decrease of electron transmission through the exit window 32.

In other embodiments, the corrosion resistant high thermal conductive layer can be a high density material such as gold. Normally, gold would not be considered desirable for such a layer because the high density of gold tends to impede the transmission of electrons therethrough. The Applicant has found that by employing a layer 32b of gold about .1 to 1 micron thick over the exterior surface of a titanium exit window foil 32a, the thermal conductivity of the exit window foil 32a can be maximized while minimizing the impedance of the electrons. In some situations, the thermal conductivity of the exit window can be increased by a factor of about 2.

In contrast, Avnery discloses a bimetallic foil window for an electron beam emitter. This foil window is formed of two different foils that are bonded together, such as aluminum with titanium, or copper with titanium for increasing the thermal conductivity of the titanium. The aluminum and the copper are located on the *interior side* of the titanium instead of the exterior

side and it can be seen that *aluminum is not corrosion resistant.* Additionally, since the high thermal conductive foils in Avnery are on the interior side of the foil window, they are not meant to and cannot provide corrosion resistance. Avnery teaches against employing gold and silver on column 4, lines 15-16. Avnery does not disclose the thicknesses of the titanium, aluminum or copper foil layers. However, in the background on column 1, lines 35-36, Avnery mentions a thickness of a window foil being .001 inches (25 microns) thick.

Accordingly, Claims 1, 12, 21 and 32 are not anticipated by Avnery since Avnery does not teach or suggest "an exit window foil about 12 microns thick or less", or a corrosion resistant layer having high thermal conductivity formed "over the exterior surface of the exit window foil for resisting corrosion and increasing thermal conductivity", as recited in Claims 1, 12, 21 and 32, as amended. Therefore, Claims 1, 12, 21 and 32, as amended, are in condition for allowance. Reconsideration is respectfully requested.

In view of the above remarks, Claims 2-5, 7-11, 13-16, 18-20, 22-25, 27-30, 33-36 and 38-40 are also not obvious in view of Avnery since Avnery does not teach or suggest the limitations recited above with regard to independent Claims 1, 12, 21 and 32, as amended, and further does not teach or suggest the thickness of the corrosion resistant layer being "about 4% to 8% the thickness of the exit window foil", as recited in Claims 2, 13, 22 and 33, the exit window comprising "titanium about 6 to 12 microns thick", as recited in Claims 3, 10, 11, 14, 23, 30, 31 and 34, and the corrosion resistant layer comprises gold "about .1 to 1 microns thick", as recited in Claims 5, 10, 16, 25, 30 and 36. Therefore, Claims 2-5, 7-11, 13-16, 18-20, 22-25, 27-30, 33-36 and 38-40 are now in condition for allowance. Reconsideration is respectfully requested.

Jacob discloses a window foil 20 (FIGs. 1 and 2) through which a particle beam 10 passes. The window foil can be Havar, aluminum, titanium, beryllium or diamond (column 4, lines 7-9). FIG. 6 discloses a diamond foil 92 having a spherical section. The diamond foil 92 is formed by deposition onto a temporary substrate surface which is later removed by chemical dissolution.

The combination of the Al/Ti or Cu/Ti bimetal foil in Avnery with the diamond window foil of Jacob does not attain the present invention as recited in Claims 6, 11, 17, 26, 31 and 37. The bonded metallic Al/Ti or Cu/Ti foils in Avnery consist of two metallic foils bonded together with the high thermal conductive material being on the interior surface. The all metal foil structures in Avnery do not suggest forming a nonmetallic material such as diamond on the exterior surface of a metallic foil. In addition, the all diamond exit window foil of Jacob is also not suggestive of covering the exterior surface of an exit window foil with diamond. Furthermore, neither Avnery nor Jacob teaches or suggests an exit window foil for an exit window about 12 microns thick or less, or a diamond layer about .25 to 2 microns thick.

Accordingly, Claims 6, 11, 17, 26, 31 and 37, are not obvious in view of Avnery and Jacob, since neither reference, alone or in combination, teaches or suggests "an exit window foil about 12 microns thick or less", as recited in independent Claims 1, 12, 21 and 32, as amended, an "exit window foil comprising titanium about 6 to 12 microns thick", as recited in independent Claims 11 and 31, a corrosion resistant layer formed "over the exterior surface of the exit window foil for resisting corrosion and increasing thermal conductivity", as recited in independent Claims 1, 11, 21 and 31, as amended, that the corrosion resistant layer comprises "diamond", as recited in Claims 6, 11, 17, 26, 31 and 37, or that the corrosion resistant diamond layer is "about .25 to 2 microns thick", as recited in Claims 11 and 31. Therefore, Claims 6, 11, 17, 26, 31 and 37 are in condition for allowance. Reconsideration is respectfully requested.

Finally, new Claims 41-44 have been added to more particularly claim the present invention. New Claims 41-44 contain the limitations of Claims 1, 6, 22 and 26, as originally filed. No new matter is introduced.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned at (978) 341-0036.

Respectfully submitted,

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MARKED UP VERSION OF AMENDMENTS

Specification Amendments Under 37 C.F.R. § 1.121(b)(1)(iii)

Replace the paragraph at page 6, lines 13 through 26 with the below paragraph marked up by way of bracketing and underlining to show the changes relative to the previous version of the paragraph.

A more detailed description of the present invention now follows. FIG. 1 generally depicts electron beam emitter 10. The exact design of electron beam emitter 10 may vary depending upon the application at hand. Typically, electron beam emitter 10 is similar to those described in U.S. Patent No. 6,407,492, issued June 18, 2002, and U.S. Patent Application Serial No[s]. [09/349,592 filed July 9, 1999 and] 09/209,024 filed December 10, 1998, the contents of which are incorporated herein by reference in their entirety. If desired, electron beam emitter 10 may have side openings on the filament housing as shown in FIG. 1 to flatten the high voltage electric field lines between the filaments 22a and the exit window 32 so that the electrons exit the filament housing 20a in a generally dispersed manner. In addition, support plate 30 may include angled openings 30a near the edges to allow electrons to pass through exit window at the edges at an outwardly directed angle, thereby allowing electrons of electron beam 15 to extend laterally beyond the sides of vacuum chamber 12. This allows multiple electron beam emitters 10 to be stacked side by side to provide wide continuous electron beam coverage.

Claim Amendments Under 37 C.F.R. § 1.121(c)(1)(ii)

1. (Amended) An exit window for an electron beam emitter through which electrons pass in an electron beam, the exit window comprising:

an exit window foil about 12 microns thick or less having an interior and an exterior surface; and

a corrosion resistant layer having high thermal conductivity formed over the exterior surface of the exit window foil for resisting corrosion and increasing thermal conductivity.

12. (Amended) An electron beam emitter comprising:

a vacuum chamber;

an electron generator positioned within the vacuum chamber for generating electrons; and

an exit window on the vacuum chamber through which the electrons exit the vacuum chamber in an electron beam, the exit window comprising an exit window foil <u>about 12 microns thick or less</u> having an interior and an exterior surface, and a corrosion resistant layer having high thermal conductivity formed over the exterior surface of the exit window foil for resisting corrosion and increasing thermal conductivity.

21. (Amended) A method of forming an exit window for an electron beam emitter through which electrons pass in an electron beam comprising:

providing an exit window foil <u>about 12 microns thick or less</u> having an interior and an exterior surface; and

forming a corrosion resistant layer having high thermal conductivity over the exterior surface of the exit window foil for resisting corrosion and increasing thermal conductivity.

32. (Amended) A method of forming an electron beam emitter comprising:

providing a vacuum chamber;

positioning an electron generator within the vacuum chamber for generating electrons; and

mounting an exit window on the vacuum chamber through which the electrons exit the vacuum chamber in an electron beam, the exit window comprising an exit window foil <u>about 12 microns thick or less</u> having an interior and an exterior surface, and a corrosion resistant layer having high thermal conductivity formed over the exterior surface of the exit window for resisting corrosion and increasing thermal conductivity.